# Aeronautical Enterprise Program Office

*Rapidly delivering war-winning capability*


U.S. AIR FORCE

## Access to Future Civil Airspace with Legacy Military Avionics

**October 2002**

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*Keep'em flying & Keep'em relevant*

# Overview

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- Airworthiness Certification & Authority
- Airworthiness & System Assurance
- Tenets of Airworthiness
- Criteria & Control Board
- Certification Process
- Program Office Responsibilities
- KC-135 Example

# Airworthiness & GATM Certification

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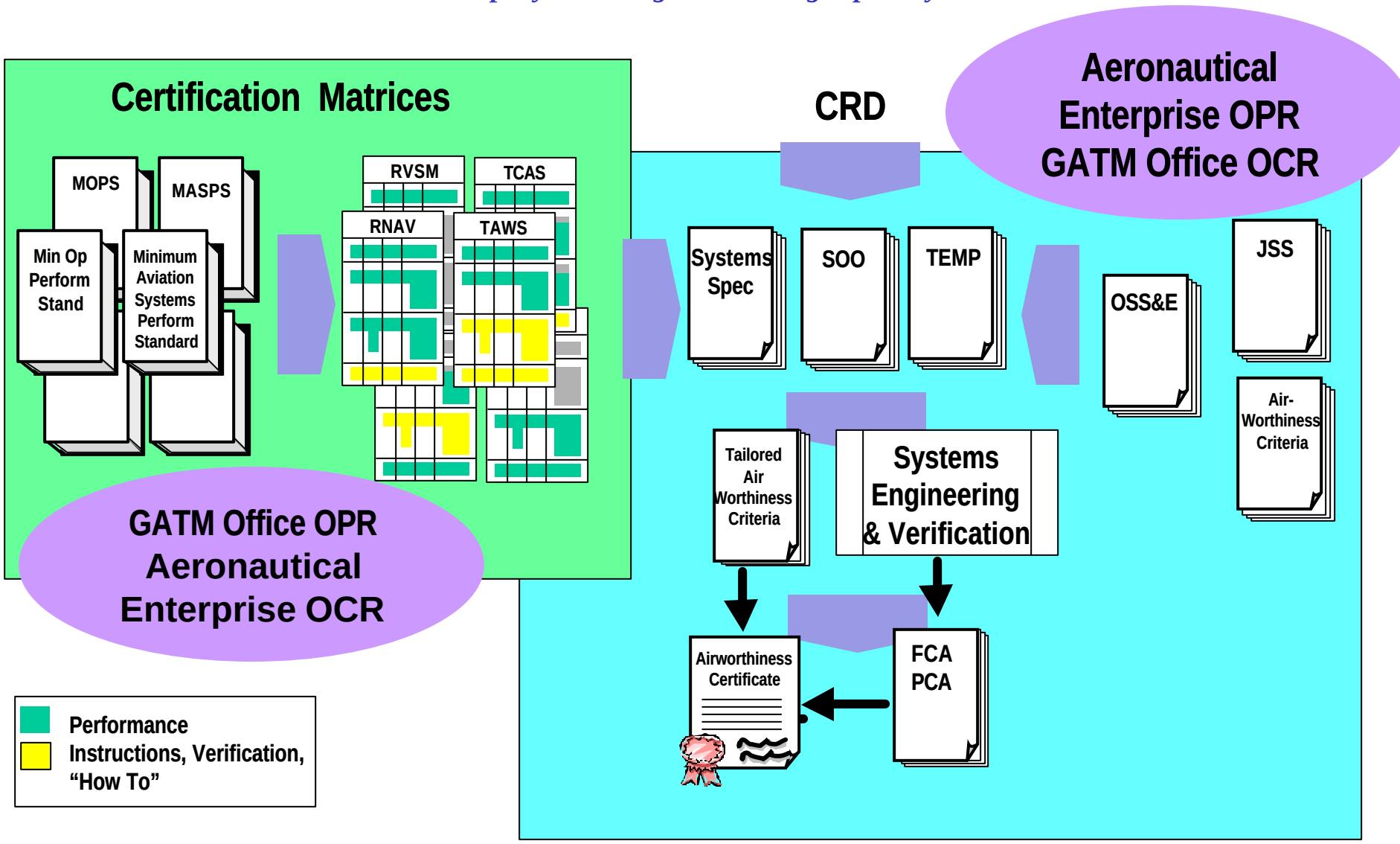

# Airworthiness Definition

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The property of an air system configuration to safely ***attain, sustain***, and ***terminate flight*** in accordance with ***approved usage and limits***

- Appropriate risk management has been completed
- The level of risk (hazard to the system, personnel, property, equipment, and environment) has been appropriately identified
- The level of risk has been accepted by the managing activity at the appropriate level

# Airworthiness Certification



- Why? Ensures verification of design attributes that make it safe to operate
- Who? Single Manager (SM) with Chief/Lead Engineer (CE/LE) support
- What? All USAF Aircraft
- When?
  - Prior to Dedicated OT&E for new programs
  - Prior to FY05 for legacy programs (AFMC Goal)
- How Long? Valid until system limitations are exceeded, system is changed, or system is decommissioned

# AFPD 62-6

## USAF Aircraft Airworthiness Certification

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- Single Manager certifies airworthiness
- Single Manager makes and documents a positive determination of safety-of-flight prior to first flight
- Airworthiness Certification Criteria Control Board establishes criteria
  - Chaired by ASC/CC, Approval Authority
  - Broad stakeholder representation
- Single Manager recommends changes to *Airworthiness Certification Criteria*
- MAJCOMs/Air National Guard/US Air Force Reserves will prohibit alterations or modifications without approval of the SM

***Allow legacy aircraft SM sufficient flexibility for certification in cost effective manner consistent with safety***

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# System Assurance Development Process



- Identify system assurance performance attributes
- Develop fault avoidance and fault tolerance techniques
- Implement design techniques in system architecture
- Perform system analysis to verify fault avoidance and tolerance techniques
- Perform system validation of fault avoidance and tolerance techniques

# Relationship of Faults, Errors and Failures

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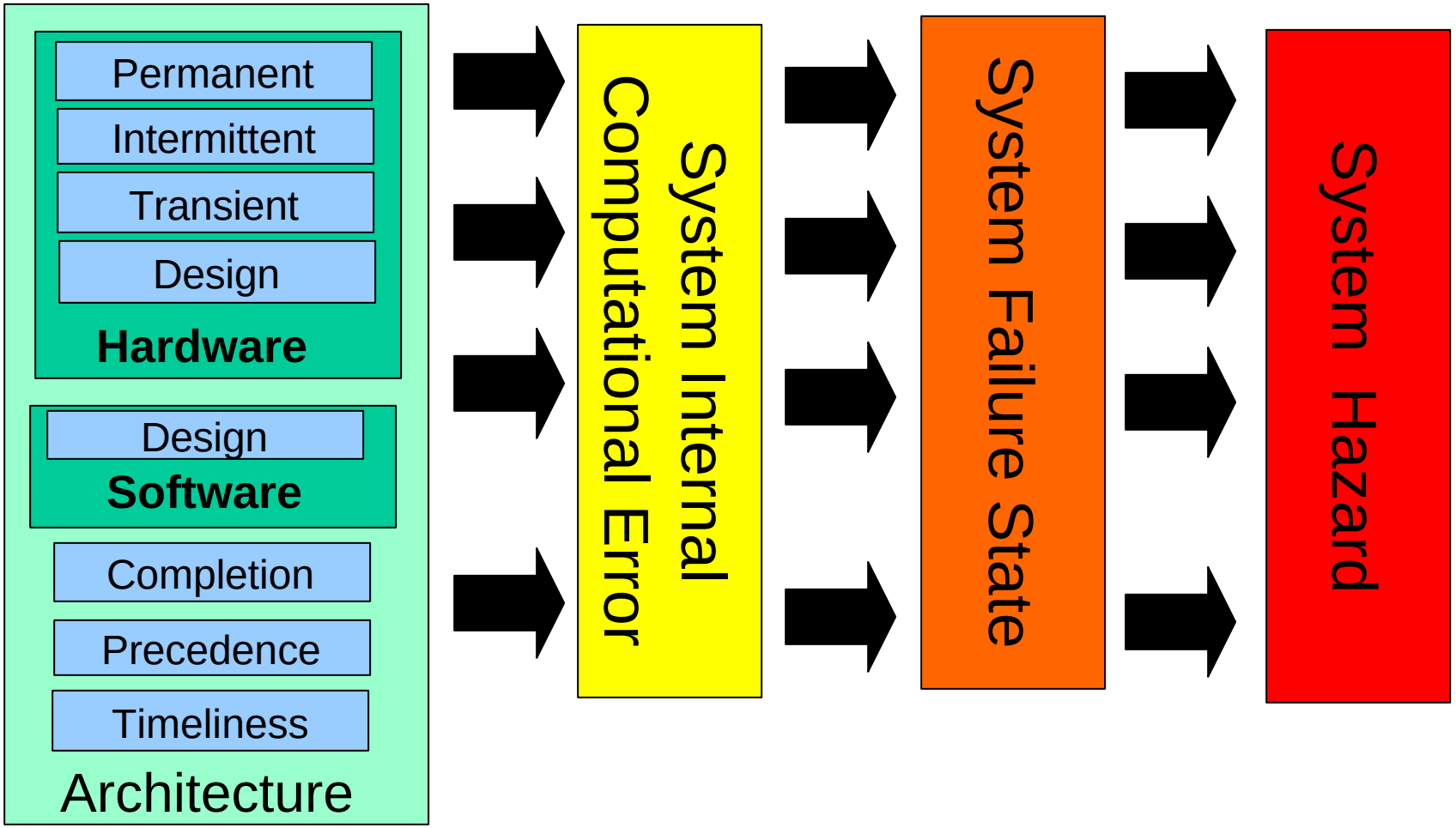

# Relationship of Fault Avoidance & Tolerance Techniques

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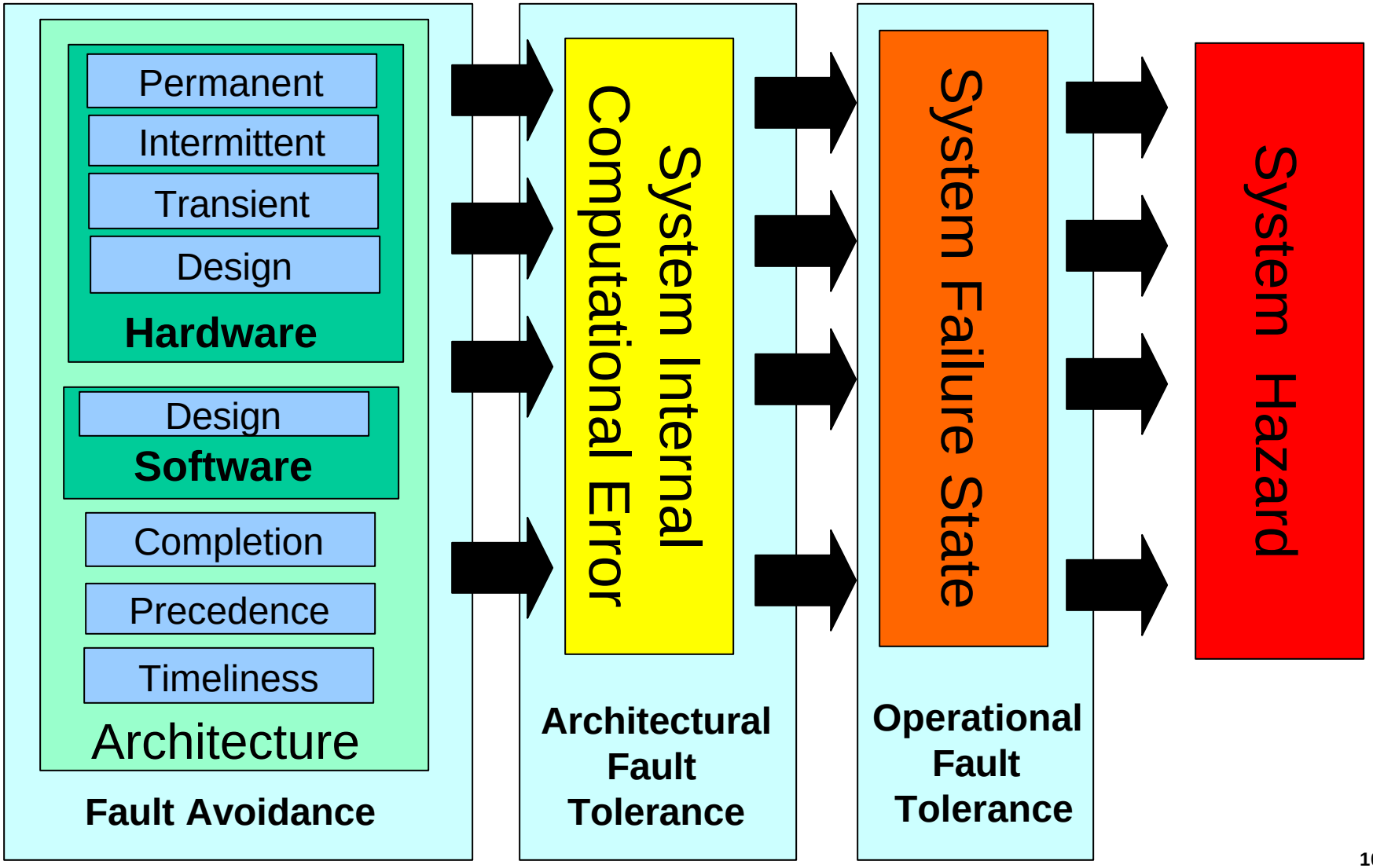
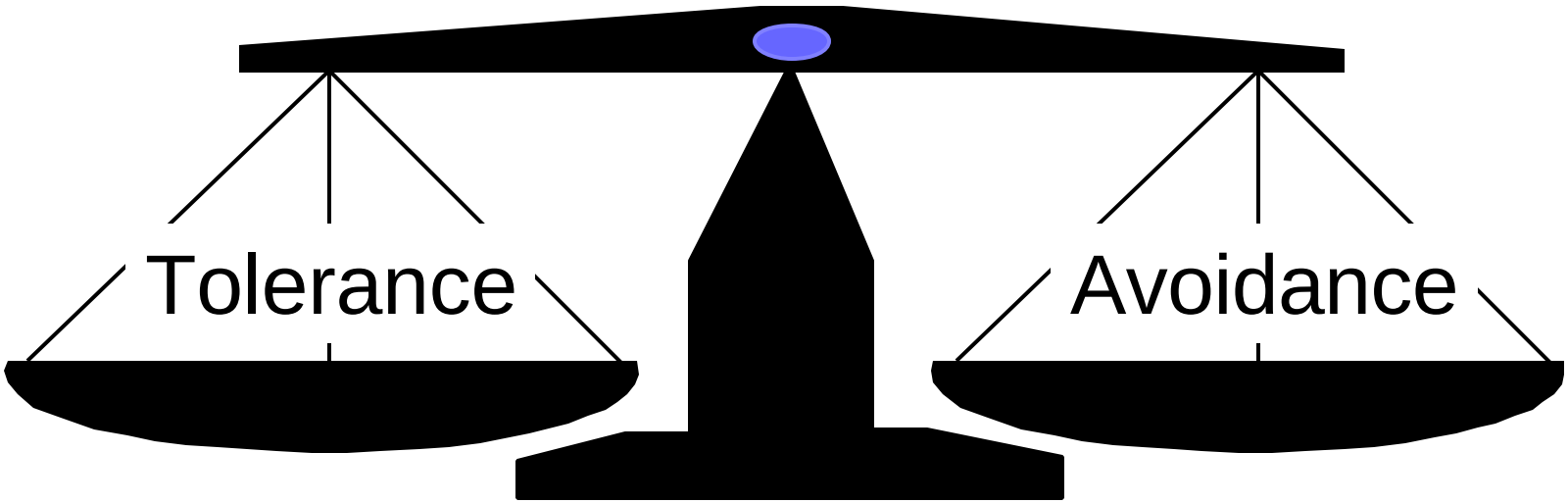


Fault Avoidance and Fault Tolerance techniques are complementary, and should both be considered in meeting system performance objectives



# Performance Classes for Safe Designs

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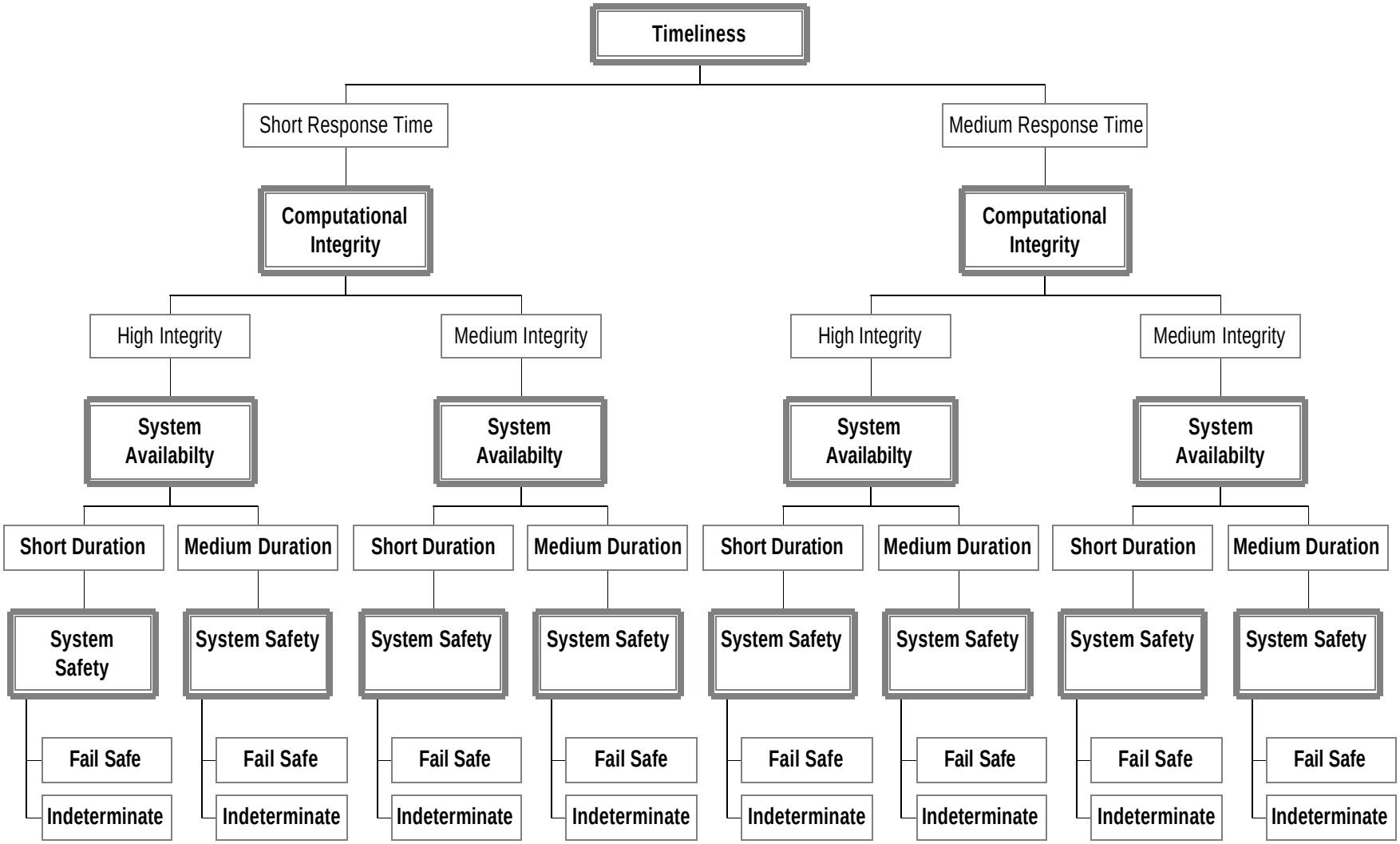

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# Tenets of Airworthiness

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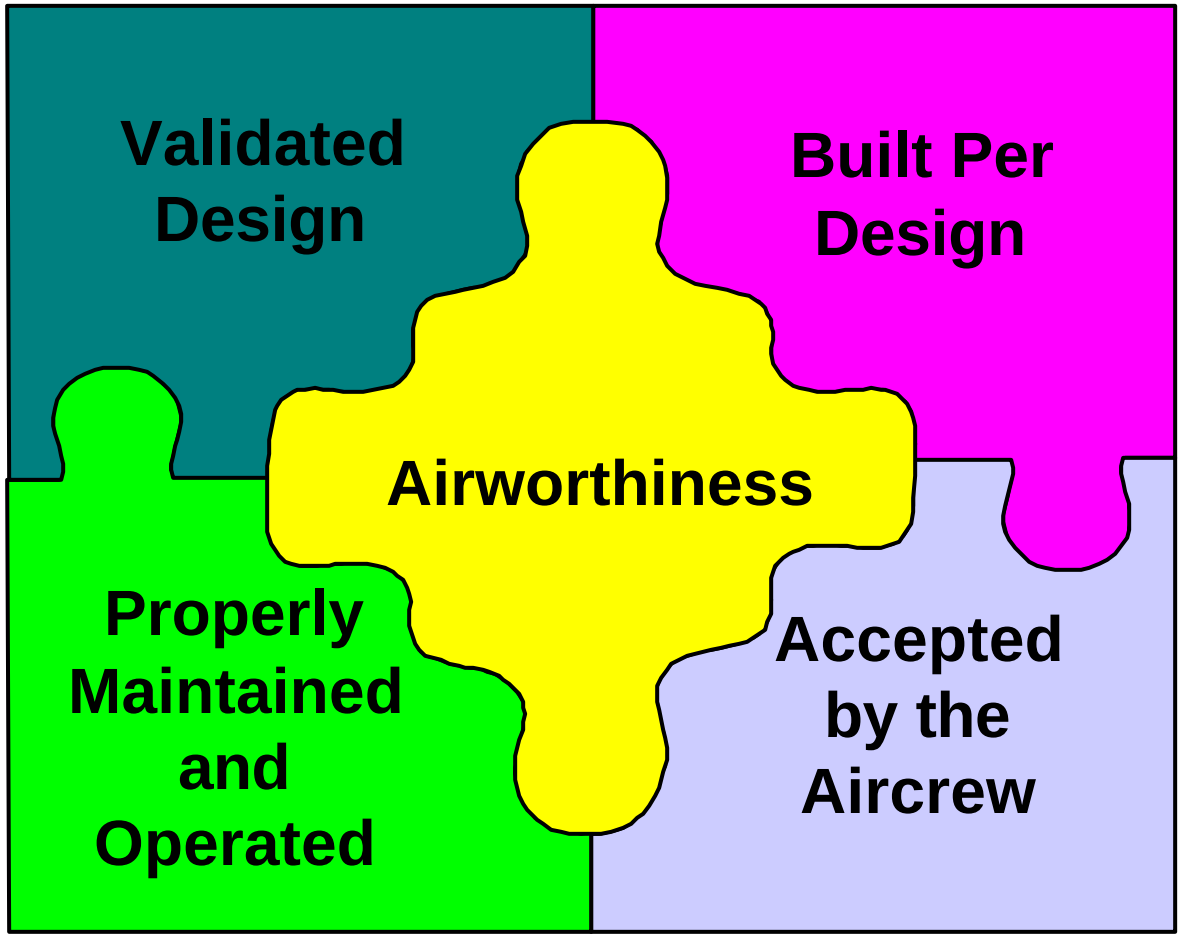

# Tenets of Airworthiness
# Validated Design

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1. Air vehicle design must be proven to meet an approved set of criteria (AFPDs 62-4, 62-5, 62-6, *Airworthiness Certification Criteria*).
   - The design (including new aircraft and modifications) must meet the design criteria in ***Airworthiness Certification Criteria*** as tailored by the CE and approved by the SM
   - "Proven" means demonstrated compliance with the airworthiness criteria by a means approved by the certifying organization
   - CE has responsibility for ensuring adequacy of compliance methodology
   - Similar to FAA Type Certificate

# Tenets of Airworthiness

## Built Per Design

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2. The air vehicle must be built in accordance with the approved design (AFPD 63-5, AFI 63-501, *Airworthiness Certification Criteria*).
   - Design presented for airworthiness approval complies with approved physical configuration
   - Critical process capabilities and quality standards exist
   - Production allowances and tolerances are within acceptable limits
   - Similar to FAA conformity and production certificates

# Tenets of Airworthiness

## Properly Maintained and Operated

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3. The air system must be operated and maintained by qualified personnel in accordance with approved documentation and procedures (AFPD 62-6, Air Force 11-2, 21, and 36 series of policies and instructions, *Airworthiness Certification Criteria*).
   - A comprehensive set of maintenance and flight manuals are used
   - Failures to flight critical elements are reported to SM & CE
   - Maintenance personnel are qualified, competent, and properly trained
   - Aircraft records are properly maintained
   - Special procedures required to preserve airworthiness are approved
   - All modifications have SM approval

# Tenets of Airworthiness

## Accepted by the Aircrew

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4. The air system must be accepted by the operating crew as being in a condition for safe operation (AFI 11-2 series).
   - Aircrew has sufficient training to detect unsafe conditions
   - Aircrew has sufficient training to make judicious decisions to continue the mission or require maintenance action

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# Airworthiness Certification Criteria Control Board

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AFPD 62-6

Certify to these criteria

ACC

SM and CE Checklist

Content Approved by Board

Published under ASC/CC signature

Enabling language for board

Changes

**Responsible for:**

* Configuration control of certification criteria (annual review required by charter)
* Approval of changes to certification criteria
* Release of airworthiness alerts

ASC/CC - Chair

AF/XOO/IL ESC ACC AMC

SAF/AQ AFSC AETC

ANG

AFMC ALCs AFSOC

AFFSA

ASC/EN AFRC

Industry

# Certification Criteria Groundrules and Assumptions

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- Top-level checklist for SMs and CEs
  - Tailorable
  - Qualitative
- Safety of flight and ground operations only
- Applicable at any point in system life cycle
- Primary focus of airworthiness certification is on the design
- Covers what needs to be addressed for airworthiness certification, not how to do it
- AC$^3$B approved changes to the ACC apply only to modifications of previously certified aircraft

# Airworthiness Certification Criteria Document

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**GENERAL (13)**

**STRUCTURES (28)**

**FLIGHT TECHNOLOGY (139)**

**PROPULSION (50)**

**SUBSYSTEMS (220)**

**CREW SYSTEMS (55)**

**DIAGNOSTICS SYSTEMS (7)**

**AVIONICS (18)**

**ELECTRICAL POWER (16)**

**COMPUTER RESOURCES (27)**

**MAINTENANCE (8)**

**ARMAMENT/STORES INTEGRATION (14)**

**OTHER (2)**

**15 SECTIONS**
**621 CRITERIA**

**ELECTROMAGNETIC ENVIRONMENTAL EFFECTS (13)**

**SYSTEM SAFETY (11)**

**Document is available at https://www.en.wpafb.af.mil/oss&e/oss&e_airworthiness.asp**

# Criteria Application



- The *Airworthiness Certification Criteria* are intended to cover all possible safety related design attributes for all types of aircraft -- new and legacy
- A Tailored Airworthiness Certification Criteria (TACC) is a permanent and active document for a specific MDS
  - **Developed by the CE** in conjunction with SM, user, and contractor
  - Identifies the minimum set of attributes which makes that system safe to operate
  - **Approved by the Single Manager after coordination by ASC/EN**
  - Basis for maintaining airworthiness certification throughout the aircraft service life
  - Changed only to include new criteria for mission/capability changes and new commercial derivative aircraft modifications that are not FAA certified

# Criteria Tailoring



- Applicable criteria cannot be deleted or modified
  - Example: Positive margins of safety for structure
- Specific criteria can be non-applicable
  - Example: Life support criteria will be N/A for a UAV
- CE can add specific criteria to applicable top-level criteria and for unique applications
  - Example: 16g crash load capability of passenger seats and supporting structure (number addition)
  - Example: Criteria for a UAV ground station (new criteria)

**Airworthiness Certification Criteria Circular No. 0002**

# Review of TACC

## HQ AFMC/EN Memo, 28 Jan 2002

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- Creating TACC and documenting method of compliance are critical technical activities leading to SM certification decision
- Directs aircraft program CEs to coordinate draft TACC with ASC/EN prior to SM approval
  - Strengthens airworthiness certification process
  - Establishes Command-level best practice to assure technical consistency
- AC$^3$B provides final resolution on any major issues related to particular airworthiness criterion

# Airworthiness Criteria Examples

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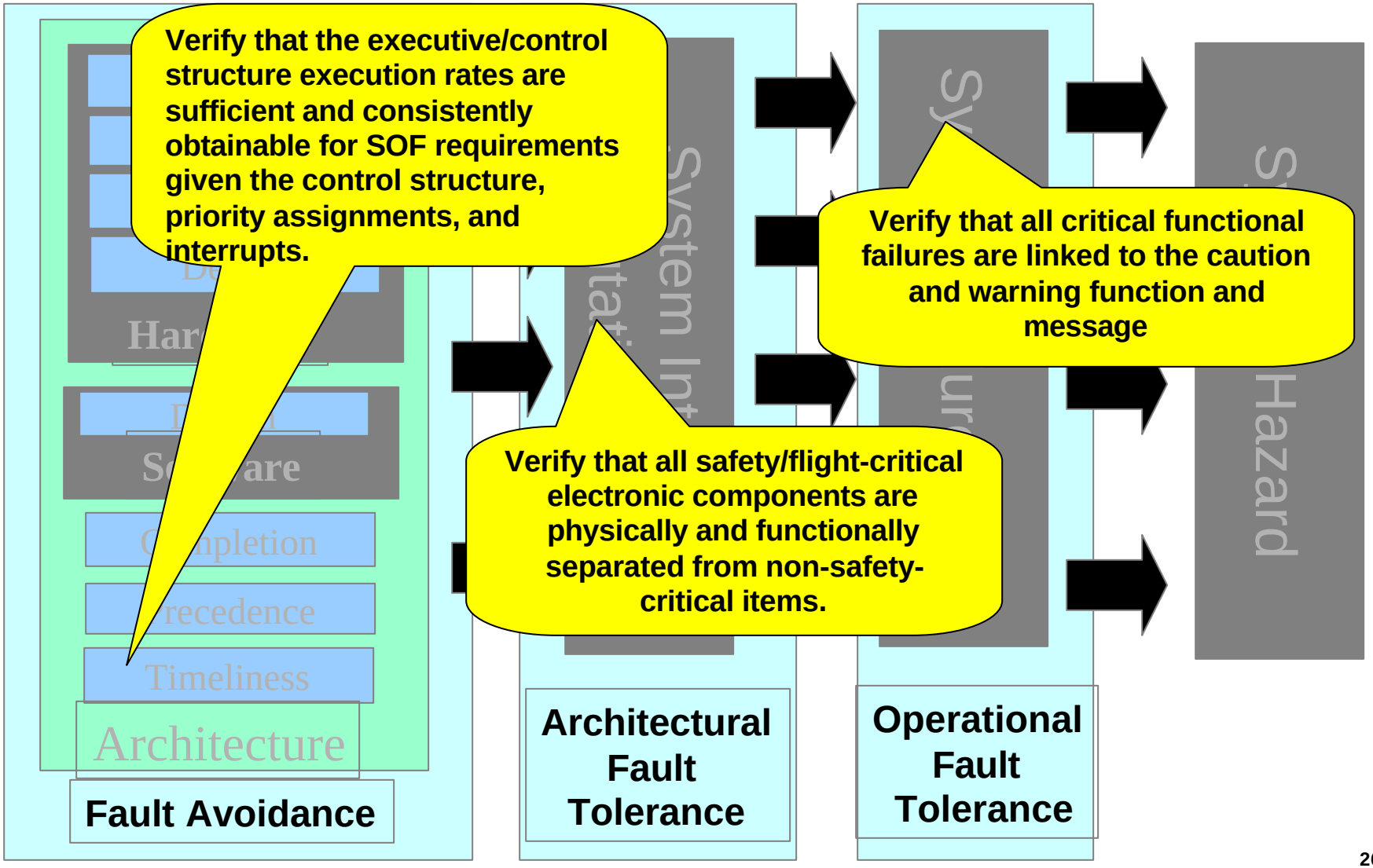

# Relationships of Certification Levels

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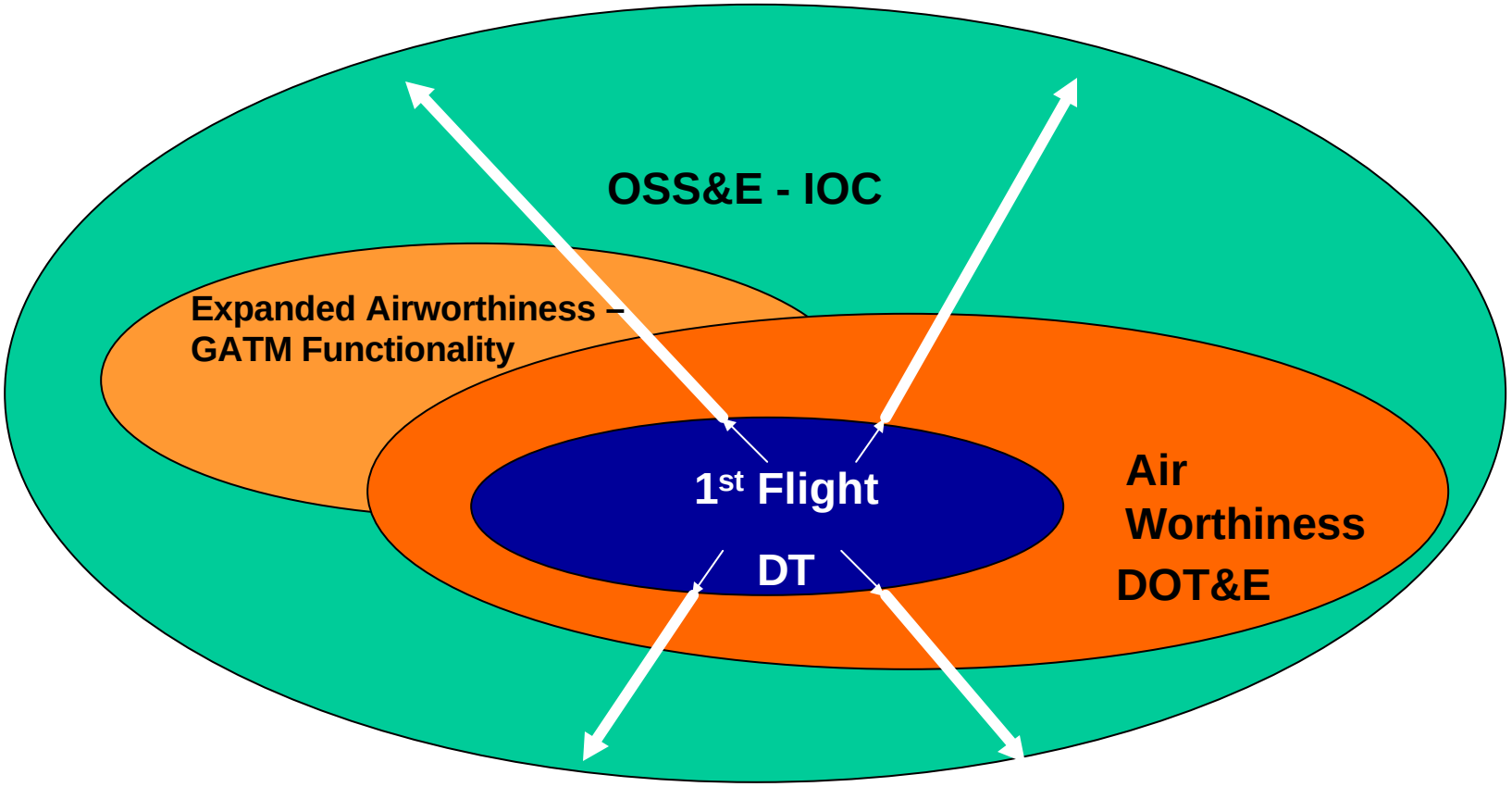

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# Airworthiness Certification Process

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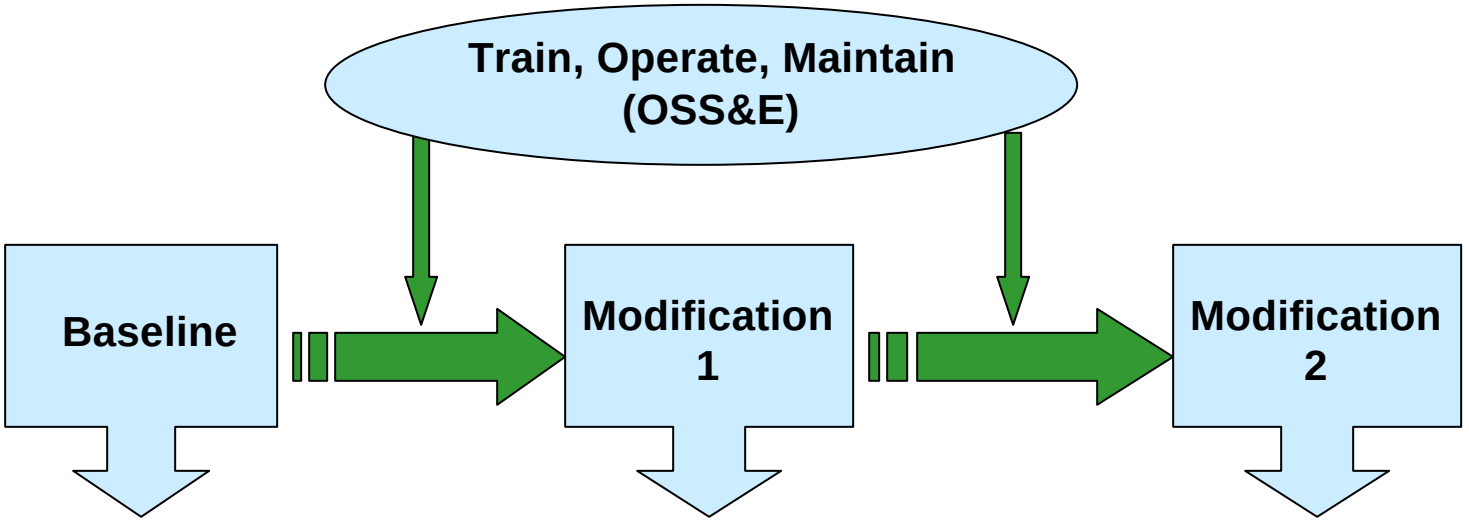


**Certifications are discrete events in a continuous airworthiness process**

# New System/Modification Airworthiness Cert Process

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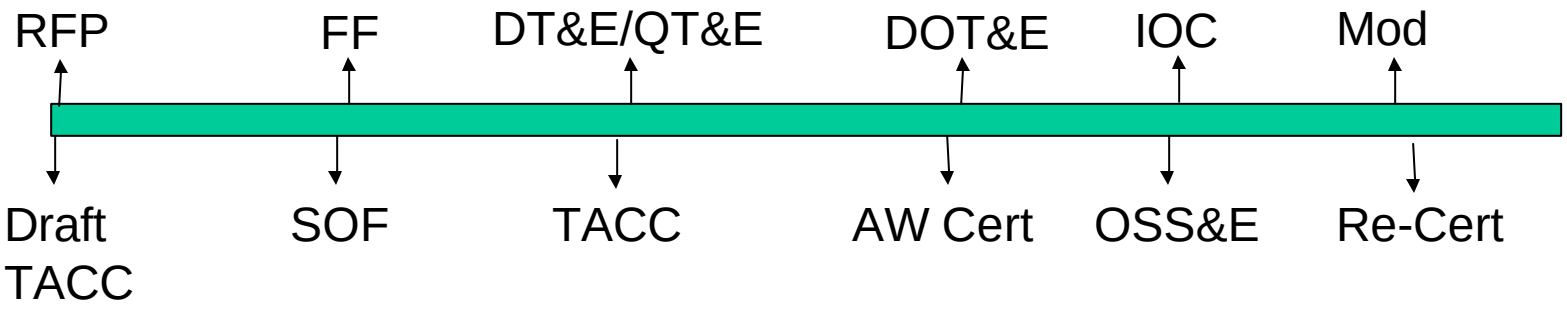

# Airworthiness Certification Process Elements

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## TOOLS

- Airworthiness Cert Criteria
- Cross Reference Table
- Joint Service Spec Guides
- OSS&E Guidance Doc.
- Training
- TOs
- FAA Documents
- Integrity Program Hdbks

## PEOPLE

**SM** **CE** User Maintainers

Contractors Engineering Staff

## CRITICAL PROCESSES

- Integrated Risk Management
- Systems Engineering

**Airworthiness Certification**

# Notification of Airworthiness Certification

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- Written notification to ASC/EN required
  - Initial certification of legacy aircraft
  - Updates due to major modifications (resulting in new configuration and flight manual change)
- Notification must include:
  - Specific reference to aircraft model
  - Copy of airworthiness certificate (sample if issued for each aircraft)
  - Copy of SM approved TACC (FAA Type Cert Basis for commercial derivative aircraft)

**Requirements from ASC/CC Memo dated 19 July 2001**

# Airworthiness Certification Documentation

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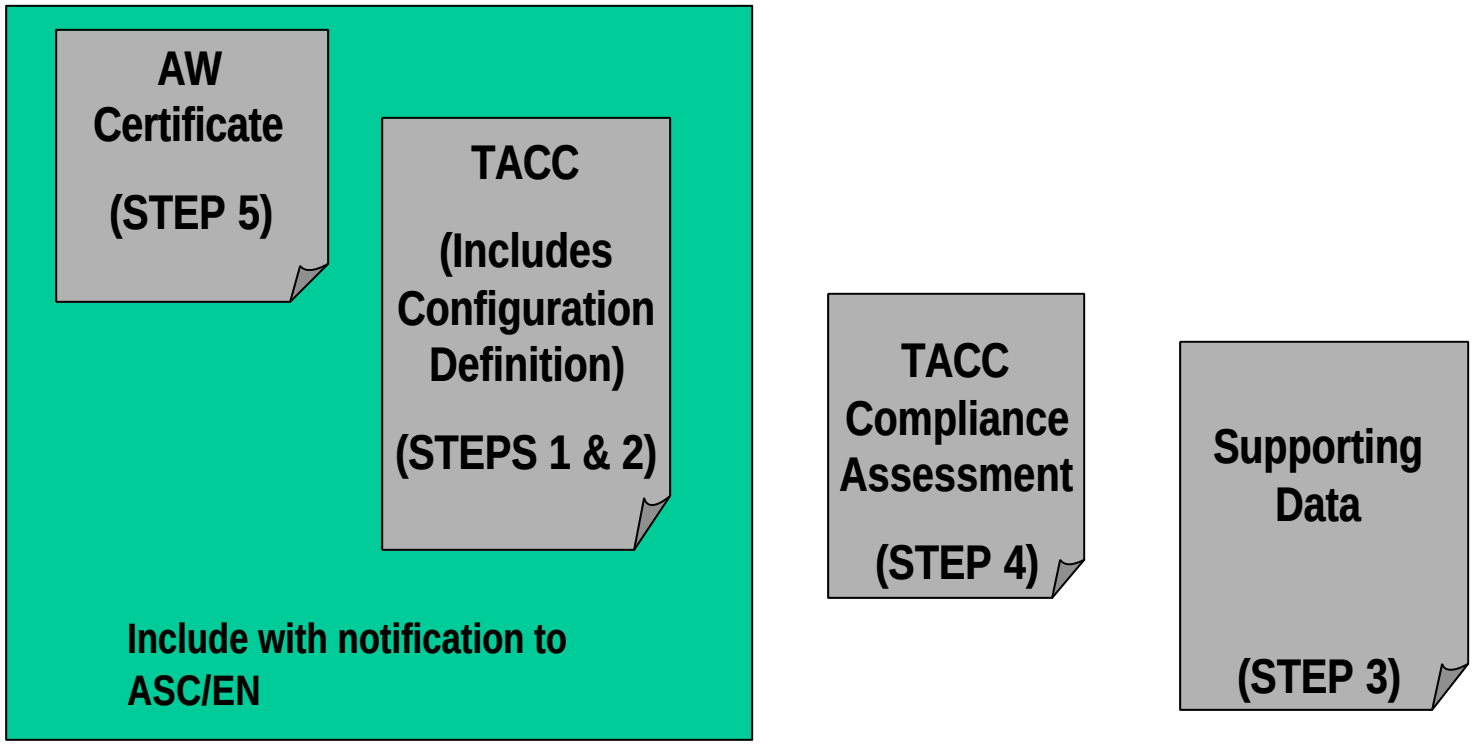


**Maintain documentation until system is decommissioned**

# Airworthiness Certificate Example

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UNITED STATES OF AMERICA
DEPARTMENT OF DEFENSE - UNITED STATES AIR FORCE

**STANDARD AIRWORTHINESS CERTIFICATE**

| 1. SERIAL NUMBER | 2. MANUFACTURER AND MODEL | 3. AIRCRAFT PRODUCTION NUMBER | 4. CATEGORY |
|---|---|---|---|
| 97-0400 | GULFSTREAM - C-37A (G-V) | 521 | TRANSPORT |

5. AUTHORITY AND BASIS IF ISSUANCE

This airworthiness certificate is issued pursuant to Air Force Policy 62-6 and Air Force Policy Directive 62-4 and certifies that, as of the date of issuance, the aircraft to which issued conforms to the approved design and is in a condition for safe operation.

6. TERMS AND CONDITIONS

Unless sooner surrendered, suspended, revoked or a termination date is otherwise established by the Single Manager (SM), this airworthiness certificate is effective as long as the maintenance, preventive maintenance and SM approved alterations are performed in accordance with approved Maintenance Manuals, and Air Force Regulations, Policy Directives and Instructions. The aircraft serial number is registered with the United States Air Force.

| DATE OF ISSUANCE | C-37A SINGLE MANAGER |
|---|---|
| | |

# Example Airworthiness Certificate Wording

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5. Authority and Basis for Issuance:

   This airworthiness certificate is issued pursuant to Air Force Policy Directive 62-6 and certifies that, as of the date of issuance, the aircraft to which issued conforms to the approved design and is in a condition for safe operation.

6. Terms and Conditions:

   Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Single Manager (SM), this airworthiness certificate is effective as long as the maintenance, preventative maintenance, and SM approved alterations are performed in accordance with approved Maintenance Manuals and Air Force Regulations, Policy Directives and Instructions. The aircraft serial number is registered with the United States Air Force.

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# SM Airworthiness Responsibilities

## AFPD 62-6

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- Make and document determination of safety-of-flight prior to first flight
- Certify aircraft airworthiness no later than start of DOT&E and document method of compliance
- Certify airworthiness of modifications and document method of compliance
- Provide written notification to ASC/EN confirming aircraft airworthiness certification in accordance with established criteria to enable reporting of policy compliance metrics
- Include instructions for continued airworthiness in TOs
- Maintain and manage data and aircraft configuration in support of airworthiness certification

# SM Airworthiness Responsibilities

## AFPD 62-6

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- Obtain and document recommendations from the Original Equipment Manufacturer (OEM)/ prime contractor when making certification and safety-of-flight determinations
- Include verification of appropriate airworthiness certification criteria as objectives in Test and Evaluation Master Plans
- May delegate to test centers/organizations, and laboratories for T-2 mods on assigned and possessed aircraft
- Recommend changes to *Airworthiness Certification Criteria* to Airworthiness Certification Criteria Control Board for consideration and provide feedback on lessons learned

# CE Airworthiness Responsibilities

## OSS&E Guidance Document

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- Define airworthiness criteria in pre-award phase for inclusion in contract
- Make recommendation to SM with respect to safety-of-flight determination prior to first flight
- Ensure necessary processes are in place to obtain an airworthiness certificate for each model or like configured group of aircraft
- Ensure all permanent or temporary modifications meet the airworthiness criteria of the system
- Provide technical content of technical manuals for continued airworthiness
- Review all airworthiness directives, advisories, and alerts for applicability and provide disposition recommendations to SM
- Identify need for changes to *Airworthiness Certification Criteria* to SM

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# KC-135 TACC

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- Program Office Placed Rockwell-Collins on contract to support TACC development
  - In support of DOT&E recommendation
- TACC covers GATM implementation for all affected areas of weapon system
  - **GENERAL**
  - **STRUCTURES**
  - **FLIGHT TECHNOLOGY**
  - **PROPULSION**
  - **SUBSYSTEMS**
  - **CREW SYSTEMS**
  - **DIAGNOSTICS SYSTEMS**
  - **AVIONICS**
  - **ELECTRICAL POWER**
  - **ELECTROMAGNETIC ENVIRONMENTAL EFFECTS**
  - **SYSTEM SAFETY**
  - **COMPUTER RESOURCES MAINTENANCE**

# Summary



- TACC formally documents those attributes of a specific aircraft type that make it safe to operate
- Airworthiness certification process addresses safety critical attributes and “meshes” with usual acquisition, sustainment, and configuration control processes
- To maintain certification, the system must be properly maintained, operated, and modified